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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
HANFORD/INL PROJECT OFFICE
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Marko Adzic
Project Manager
Teck American Incorporated
501 North Riverpoint Boulevard, Suite 300
Spokane, Washington 99202

Dear Mr. Adzic,

EPA is pleased to provide our Level of Effort (LOE) paper for soil sampling at the Upper Columbia River Site (Site). The LOE describes important data gaps in our knowledge of soil contaminant levels that must be filled to support the ongoing Remedial investigation. The LOE also describes in some detail studies that are needed to fill the identified data gaps. Preliminary data needs to be collected to help determine what soil layer should be sampled. This preliminary data collection effort should not interfere with developing the Quality Assurance Project Plan (QAPP); however, EPA recognizes that parts of the QAPP may need to be updated depending on the results from the preliminary data. In the interest of expediting the review of the preliminary data needs, EPA would be amenable to separate QAPPs - one for the preliminary data, and one for the main study. If Teck chooses to develop two QAPPs, both must be submitted to EPA simultaneously. The QAPP(s) must be consistent with the enclosed LOE. We look forward to working with Teck on this study.

Sincerely,

Laura C. Buelow
Project Manager

Enclosure: EPA Technical Team Level of Effort (LOE) for Sampling and Analysis of Soil in the Upper Columbia River Basin (Soil LOE)

cc: Dan Audet, U.S. Department of Interior
Patti Bailey, Confederated Tribes of the Colville Reservation
Randy Connolly, Spokane Tribe of Indians
John Roland, Washington Department of Ecology

EPA Technical Team Level of Effort (LOE) for Sampling and Analysis of Soil in the Upper Columbia River Basin (Soil LOE)

Date: November 2012

Developed by: EPA Technical Team

1. Goals

This document outlines the expected content of a phased process for data collection to evaluate human health and ecological risks associated with contaminants in uplands soil originating from operations at the Trail smelter or other nearby smelters (e.g. Le Roi). The first phase of this process is to provide a summary of the level of effort (LOE) expected to delineate and characterize soil contamination within the Upper Columbia River (UCR) Site. The process will then proceed with the approval of a quality assurance project plan (QAPP) for collection and analysis of soil samples at the UCR site. The soil data to be generated as a result of implementation of the soil QAPP will be of suitable quality for the assessment of risks to human and ecological receptors that may experience exposure to soils within the UCR Site.

Specific risk-related questions that will be addressed by measuring concentrations of chemicals of interest (COIs) in soil and associated soil chemistry parameters are:

- What are the concentrations of COIs in soils that have potentially been influenced by air emissions, fluvial deposition of sediment onto floodplains adjacent to the UCR, and windblown transport of sediment to nearby uplands?
- Where have soils been influenced by emissions, floodplain, or windblown sediment re-deposition?
- What are the concentrations of COIs in soils from background areas?
- Do COI concentrations in soil pose unacceptable risks to human health and the environment?
    - Will reproduction, growth or survival of terrestrial invertebrates or plants be adversely affected by COIs in UCR soils?
    - Will reproduction, growth or survival of adult life stages of amphibians or reptiles (herpetofauna) be adversely affected by COIs in UCR soils or soil-associated food items?
    - Will reproduction, growth or survival of terrestrial birds or mammals be adversely affected by COIs in UCR soils or dietary food items?
    - Will the health of people working, recreating, or living on the site be adversely affected by COIs in UCR soils?

Once collection of Phase 1 soil data is complete, a risk screening evaluation will be performed using provisional regional background[1] concentrations and both EPA ecological soil screening levels (EcoSSLs) for ecological receptors (http://www.epa.gov/ecotox/ecossl/) and human health risk-based concentrations (RBCs) developed by SRC for evaluation of UCR beach sediment data (SRC, 2012). If exceedances of provisional regional background and EcoSSLs or human health RBCs are observed, a second phase of upland characterization will be performed in consultation with EPA.

The purpose of the second phase (Phase 2) of soil sampling would be to perform additional characterization as required by EPA to support further risk evaluations in those areas where screening of the Phase 1 soil data indicates possible risks to human health or ecological receptors, or to address uncertainties identified through the evaluation of the Phase 1 data.

This LOE document only addresses EPA's anticipated minimum level of effort for Phase 1 soil characterization (i.e., soil sampling and analyses necessary to delineate and characterize soil-associated risks in the UCR). Additional input will be provided by EPA prior to development of a Phase 2 soil QAPP.

2. General Approach

The conceptual site model for the site (Figures 4-1 and 4-6; Teck American, Inc., 2011) identified point source aerial deposition (e.g., metals originating from the Trail or other smelters within the UCR basin), hydraulic deposition on relict floodplains, and windblown remobilization of exposed sediments into upland areas within the UCR basin as distinct sources/pathways for contaminants in soils within the UCR site.

General soil sampling design questions include:

- What analytes should be measured?
- Should field analytical methods (e.g., X-ray fluorescence [XRF]) be applied?
- What soils should be sampled (depths, materials)?
- How should provisional regional background concentrations be derived?

Answers to the following questions differ depending on source/pathway being considered:

- Where should soil samples be collected?
- What sampling design should be employed?
- How many soil samples should be collected?

General and source/pathway specific soil sampling design attributes that must be addressed as part of the QAPP are presented below.

[1] Described in Section 3.4

3.0 General Soil Sampling Design Attributes

3.1 Analytes to be Measured

All soil samples will be analyzed for TAL metals[2]. Twenty percent (20%) of samples with lead concentrations greater than 100 mg/kg will be analyzed for lead bioaccessibility (U.S. EPA, 2008) to estimate the bioavailability of lead in the EPA integrated exposure uptake biokinetic (IEUBK) lead model in the human health risk assessment (U.S. EPA, 2007).

Data on soil parameters that affect bioavailability of chemicals will be collected from all soil samples analyzed by the analytical laboratory including pH, cation exchange capacity (CEC), total organic carbon (TOC), pH, and grain size distribution. Moisture content will be measured and all concentrations reported on a dry weight basis.

3.2 Application of Field Analytical Methods

Field analytical methods and approaches, such as XRF, pilot test steps, and systematic screening steps may provide useful tools for conceptual site model refinement by progressively evaluating concentrations of selected constituents, informing statistical considerations, screening geographic influences on emission patterns, and determining preferred sampling areas under Phase 1.

3.3 What Should be Sampled

3.3.1 Sampling Depth

The EPA suggests that concentrations of metals from smelter emissions are likely to be highest either in the uppermost layer of the mineral horizon or in the lowest litter horizon (Oa), which lies directly above the mineral soil. Before the soil survey is started, soil profiles should be sampled at six sites representing a variety of habitats, and include at least two sites beneath Ponderosa Pine with a thick layer of litter. This preliminary work is designed to ensure that the sampling layer is properly selected. Each sample should be a point sample and include Oa organic matter from the litter layer and samples of mineral soil as follows : 0.-2.5 cm, 2.5 – 5.0 cm, 5.0-15 cm, 15-25 cm, and 25- 50 cm. If the uppermost mineral layer (0-2.5 cm or 2.5- 5.0 cm) clearly contains the highest metal concentrations, then EPA suggests that layer will be predominantly sampled in the main survey. However, if the metal concentrations are higher in the Oa than in the mineral layers, such that the concentrations in the mineral horizons would give a misleading indication of the extent of the contamination, then the sampling plan will be modified after additional consultation with the EPA. This preliminary sampling is included over concern that a thick litter horizon beneath pine might be preventing lead and possibly other metals from reaching the mineral horizon.

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[2] TAL Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium and Zinc (EPA 200.8/6020).

We further note that the field crews will have to be trained to ensure that the samples are collected consistently and according to the QAPP; field personnel should have sufficient knowledge of soils and soil sampling to ensure appropriate soil horizons are sampled and all samples are collected consistently and appropriately.

3.3.2 Grain Size

Soil samples collected to assess potential human health exposure and risk should be sieved using a No. 100 mesh (0.149 mm) sieve. To support ecological risk evaluation, soil samples should be sieved using a No. 10 mesh (2 mm) sieve. Each sample will be divided first, sieved separately for both human health and ecological risk, and then each size fraction will be analyzed for COIs.

3.4 Derivation of Provisional Regional Background

Teck should propose a method to develop provisional regional background estimates for metals in soil and sediment, subject to EPA review and approval as an input to the Phase 1 Soil QAPP. Specifically, provisional background estimates should include an analysis of most recent re-analyses of archived NURE samples to estimate background threshold values, mean and variance estimates, and potential additional analyses using geo-spatial data (http://tin.er.usgs.gov/geochem/). Estimates of mean and variance will be needed to compare incremental composites sample (ICS) results to background (U.S. EPA, 2002; U. S. EPA, 2011). Teck should consider taking additional ICS samples to supplement the NURE data. Note that samples for provisional regional background determination should be selected such that they are at least 50 meters (m) from roads to prevent potential contamination associated with road fill dust dispersion or lead from leaded gasoline emissions (Filippelli, 2012); adjustments could apply to minimally used roadways or jeep trails.

4.0 Source/Pathway-Specific Soil Sampling Design Attributes

Soil sampling design attributes specific to the three separate pathways identified for COI transport (e.g., air emissions, floodplain deposition, and windblown re-deposition) are described below.

4.1 Point Source Aerial Deposition - Soil and Upland Lakes

Aerial emissions from the Trail smelter and other nearby smelters may be deposited on or washed into down-gradient upland soils, lakes, and wetlands. Sampling design attributes for this pathway in these environments are presented below.

4.1.1 Where Should Soil Samples be Collected?

Characterization of soil contamination due to point-source aerial deposition will initially be based on a combination of the area identified in Teck American, Inc. 2011(2011), and the general area identified as being affected by the historic smelter-associated sulfur dioxide plume (ICF, 2011; U.S. Department of Agriculture, 1936). This area will not be limited to the river corridor, but will also include associated upland areas. Teck should investigate the utility of sampling on a sub-watershed basis taking into account the watershed topography and the potential for

aerial deposition to migrate "up" each watershed. Samples should be located at least 50 m from primary roads to prevent potential bias associated with lead from road fill dust dispersion or leaded gasoline emissions (Filippelli, 2012). Lands that have experienced known farming, such as tilling disturbances also should be avoided or clearly documented.

Ultimately, the bounds of the area of risk will be defined by whether resulting concentrations of COIs in soil exceed the higher of either provisional regional background and the lowest EcoSSL (http://www.epa.gov/ecotox/ecossl/) or human health RBC (SRC 2012). If samples within or at the margins of the initial characterization area exceed background or risk values, additional step-out sampling will be considered for the Phase 2 soil sampling effort.

4.1.2 Where Should Upland Lake Samples be Collected

EPA is concerned that the fine particles originating from the Trail Smelter might be transported directly or by surface runoff to lakes or wetlands in the Upper Columbia watershed. To assess this concern, EPA is requiring a phased lake study in addition to the soil study. The area of potential risk to lakes (and wetlands) would be defined by whether concentrations of COIs in sediment and wetland soils exceed the higher of either provisional regional background or risk screening benchmarks (EcoSSLs or human health RBCs, whichever is lower). The first phase of the lake study will evaluate existing data and at least five lakes in the UCR watershed located near the Canadian border.

4.1. 3 How Should Soil Samples be Collected and Processed?

Incremental composite sampling designs (Interstate Technology & Regulatory Council [ITRC], 2011) incorporating stratified systematic gridding approaches should be used to collect representative samples from areas potentially impacted by point source aerial deposition (e.g. Trail and Le Roi smelters). Sampling density should consider and identify slope orientation, elevation, topography, and distance from known or likely sources of metals emissions. Systematic selection of smaller, representative *sampling units* within larger grid cells (decision units) must be considered to maintain a manageable sampling area (U. S. EPA, 2011). A deliberate, sequential sampling strategy will likely be required to characterize potential risks at the scale of this study. The final decision units should be no larger than 25 acres. This is consistent with larger exposure areas previously sampled on UCR beaches for the human health risk assessment and also meets ecological risk assessment needs by approximating the home range of long-tailed weasels (*Mustela frenata)*, a receptor resident in the area (Sheffield and Thomas 1997). The QAPP should specify sample processing methods to ensure the analytic subsample represents field conditions and meets project specified data quality objectives within the context of systematic planning to support quality and defensible decision making (Crumbling, 2002; Crumbling et al., 2004; Gerlach and Nocerino, 2003; U.S. EPA, 2006a). In addition, the sampling plan must identify the maximum area of contamination that sampling will not be able to quantify.

4.1.4 How Should Upland Lake Samples be Collected and Processed?

ICS samples of sediment and soil will be collected from and adjacent to each lake and analyzed for TAL metals and other appropriate parameters. Sediment and soil data from within or adjacent to at least five lakes will be screened against provisional regional background and terrestrial risk benchmarks (EcoSSLs or human health RBCs) or sediment thresholds to quantify the presence and magnitude of risks. Comparisons between sediment and adjacent soil concentrations will also be performed to evaluate for possible metals enrichment ratios in lakes that may inform potential future sampling.

Additional phases of data collection and analysis of upland lakes and wetlands may be necessary if 1) the initial lake study identifies risks (exceedances of risk screen benchmarks) or metals enrichment in lake sediments, (exceedances of provisional background) or 2) additional lakes or wetlands are identified that fall within the area of potential risk as defined above, or 3) soil concentrations adjacent to other lakes exceed either the terrestrial risk benchmarks (EcoSSLs or human health RBCs) or sediment thresholds.

4.1.5 How Many Soil Samples Should be Collected?

The number of samples to be collected will be determined based on the area being characterized, the size of the decision unit, the sampling approach chosen, and the size of the sampling unit. Systematic and interim steps using progressive, multiple decision unit configurations may be necessary to properly assess required factors like those noted above (e.g., slope, aspect, elevation, distance to point source, minimum areas, etc.).

4.1.6 How Many Upland Lake Samples Should be Collected?

A minimum of one ICS sediment sample should be collected from within each lake and two ICS soil samples from the vicinity of each lake.

4.2 Relict Flood Plain

4.2. 1 Where Should Soil Samples be Collected?

For the purposes of this LOE, a relict floodplain is defined as an area that may have been subjected to flooding under past flow conditions but which is not expected to be flooded under present flow and pool level management controls. The area between high pool seasonally inundated lands or floodplain and the maximum pre-1973 strandline represents the relict floodplain. This area has been initially delineated based on analyses from Teck American, Inc. (2011). Closer review, evaluation, detailed presentation, and sampling approach for these environments will be performed by Teck, and presented in the draft QAPP. The five largest relict floodplain areas located in the upper reaches of the UCR Site, as identified by Teck, are located in the vicinity of Northport and range in size from approximately 81 acres to 268 acres. Soil samples will be collected from each of these relict floodplain areas. Should concentrations of COIs in relict floodplain soil exceed the higher of either provisional regional background and the lowest EcoSSL (http://www.epa.gov/ecotox/ecossl/) or human health RBC (SRC 2012),

sampling of additional downstream relict floodplains will be considered for the Phase 2 soil sampling effort.

4.2.2 How Should Soil Samples be Collected and Processed?

Samples should be collected using an ICS design consistent with guidance specifying a minimum of 30 increments, and associated replicate samples, to ensure representative estimates of average values of TAL metals and associated estimates of variance (ITRC 2012; EPA U.S. EPA, 2011b; U.S. EPA United States Environmental Protection Agency, 2011). ICS samples have been demonstrated to produce reproducible and precise estimates of average concentrations with specified areas (decision units). The decision units should be no larger than 25 acres. This is consistent with larger exposure areas previously sampled on UCR beaches for the human health risk assessment and also meets ecological risk assessment needs by approximating the home range of long-tailed weasels (*Mustela frenata*)), a receptor resident in the area (Sheffield and Thomas, 1997). The sampling plan should specify sample processing methods to ensure the analytic subsample represents field conditions and meets project specified data quality objectives within the context of systematic planning to support quality and defensible decision making (Crumbling, 2002; Crumbling et al., 2004; Gerlach and Nocerino, 2003; U.S. EPA, 2006a). In addition, the sampling plan must identify the maximum area of contamination that sampling will not be able to quantify.

4.2.3 How Many Samples Should be Collected?

The number of samples to be collected will be determined based on the area being characterized, the size of the decision unit, and the size of the sampling unit. Systematic and interim steps using progressive, multiple decision unit configurations may be necessary to properly assess influencing factors for distribution of COIs in relict floodplain areas.

4.3 Wind-blown Re-deposition

4.3.1 Where Should Samples be Collected?

An analysis of the frequency, velocity, and direction of winds, coupled with orientation and structure of the shoreline of the UCR and Lake Roosevelt was conducted by Teck to identify locations along the UCR where wind-blown re-deposition of contaminants may be expected to occur (Teck American, Inc., 2011). This analysis identified two likely areas: one near Marcus Flats and one near Seven Bays. Samples will be collected to characterize wind deposition down-gradient of one or more beaches near each of these areas for the purpose of evaluating risks to ecological receptors. Evans Campground and/or Welty Bay are recommended for consideration in the Marcus Flats Area, and Columbia and/or Naborlee beaches are recommended for consideration in the Seven Bays Area.

4.3.2 How Should Samples be Collected and Processed?

Samples to characterize wind-blown re-deposition of contaminants will be collected using elongated ICS polygons that step out from exposed sediments at shoreline into adjacent upland

habitat. Sampling should extend for at least 500 m or until field measurements using XRF indicate concentrations are consistent with provisional background concentrations.

4.3.3 How Many Samples Should be Collected?

The number of samples to be collected will be determined based on the area being characterized, the size of the decision unit, and the size of the sampling unit. In addition, the sampling plan must identify the maximum area of contamination that sampling will not be able to quantify.

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